is undoubtedly associated with reversed gradients brought about by unfavorable conditions of confinement.

These changes in gradients of hairs were studied particularly in *Griffithsia*.[17] If conditions are not extreme, obliteration or reversal of the axial gradient is followed by cell separation, and the death of some of the cells, the death-rate being higher among isolated apical cells than among those more basally situated. The cells which do not die usually proceed to grow new apical cells, which are found to arise at the most susceptible end of the old cells. This is usually the *basal* end, because the normal gradient had been reversed before the cells were disconnected. Rhizoids, however, arise only on those parts of the cell which have the lowest metabolic rates or lowest susceptibility.

The general conclusion of all this work is summarized admirably in the words of the author: "The facts support the conclusion that a gradient in metabolic rate, protoplasmic condition, or whatever we prefer to call it, of which the susceptibility gradient is within certain limits an indicator, constitutes physiological polarity in protoplasm, and that such a gradient is not an inherent property of protoplasm, but may be determined and altered by external factors."

Students who desire to repeat some of these experiments for themselves will find a recent paper of interest.[18] The axial gradient may be very beautifully demonstrated colorimetrically by the use of dilute solutions of potassium permanganate. The protoplasm reduces the permanganate and takes on a brown color, which appears first and deepest in the most active regions. Concentrations of M/1000 to M/100,000 should be used for such experiments.—C. A. SHULL.

Biology and culture of the higher fungi.—Among recent contributions to our knowledge of this difficult subject is a paper by BOYER[19]. The first part deals with attempts at spore germination and culture of over 60 species, and the second gives in more detail the results of his work with *Morchella* and *Psaliota*.

He recognizes three types of higher fungi: (1) pure saprophytes, (2) facultative parasites, and (3) mycorhizal forms which are constantly associated with certain trees. Saprophytes, he finds, grow readily on culture media, and many give rise to carpophores; while many of the mycorhizal group cannot be grown in pure cultures on any of the many types of media tried. Between pure saprophytes and forms which will not grow on culture media he finds

[17] CHILD, C. M., Experimental alteration of the axial gradient in the alga *Griffithsia Bornetiana*. Biol. Bull. **32**:213–233. 1917.

[18] ———, Demonstration of the axial gradients by means of potassium permanganate. Biol. Bull. **36**:133–147. 1919.

[19] BOYER, G., Études sur la biologie et la culture des champignons superieurs. pp. 116. *pls. 4. figs. 20.* Bordeaux. 1918.

gradations in dependence upon the mycorhizal habit. Some will make only a very slight mycelial growth in cultures, while others will form abundant mycelia, but never develop carpophores. Field experiments also confirm this mycorhizal dependence, but attempts to trace mycelium from carpophore to tree were seldom successful. He considers the mycorhizal relationship to be symbiotic, the green plant furnishing carbohydrates and in return receiving water and salts, especially nitrogenous substances which the fungi probably obtain by the fixation of free nitrogen.

As a source of cultures he first tried the germination of spores. Various media and methods of treating spores were tried, but no germinations from mycorhizal forms such as tubers or amanitas were obtained, and from other forms the mycelium obtained was seldom vigorous. Because of this he resorted to the use of portions of the carpophore, flamed over a Bunsen burner, as a source of cultures, and found this (which he erroneously considers a new process) much more satisfactory. In this manner he obtained cultures of 24 species which he describes, giving figures for 17 of them. While many media were used, he found a decoction from carrots, solidified with gelose (a gum derived from agar-agar), the most satisfactory. Cultural variations bring into question the validity of some specific characters, such as size, color, and characters due to substratum.

In his studies of *Morchella* cultures were obtained from single spores. The mycelium was very vigorous, growing well at 10–12° C. Sclerotia 0.5–4 mm. in diameter appear in 10–15 days. No conidia or ascocarps were formed. He attributes the absence of ascocarps either to the limited mycelial growth in cultures, or, as he considers more probable, to the necessity of a mycorhizal host prior to ascocarp formation.

Cultures obtained from the spores of *Psaliota* were always weak, while those from portions of the carpophore were very vigorous. From his pure cultures he easily developed successful commercial spawn. Cultures from one carpophore always developed carpophores with the same varietal characters as the original, which is a great practical advantage.—LEVA B. WALKER.

Identification of mahoganies.—To meet the need of some adequate method for distinguishing the different commercial timbers now classed as mahoganies, DIXON[20] has prepared (1) a concise working definition of the term mahogany, and (2) an anatomical key accompanied by detailed descriptions for the identification of some of the more common kinds by means of their microscopic characters. The constant increase in the number of species of mahogany-yielding trees in economic use, and the doubtful authenticity of many of the specimens derived from commercial sources, have made the construction of such a scheme of classification most difficult.

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[20] DIXON, H. H., Mahogany, the recognition of some of the different kinds by their microscopic characteristics. Notes from the Bot. School, Trinity College, Dublin 3:58. *pls. 22–54.* 1919.